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(54) **Joints between the edges of panels**

(57) Joints between the edges of FRP panels 11 are made by bonding preformed battens 15, 16 along the edges of the panels and jointing the battens at mating surfaces, which surfaces may be convex and concave part-circular to enable the panels to be joined at a variety of angles. Each batten may be formed, in cross-section, with a nose portion 17 bearing the mating surface, and a tail portion slotted to receive the respective panel edge margin or formed as a tongue 12 to be lap-jointed to the panel edge margin or to fit between the edge margins of the two outer skins 13 of a panel of sandwich construction. Glue may be applied to the joint faces before assembly or injected after. Screws 20 may draw the joint together and screws 21 may provide a temporary fixing during glue curing.

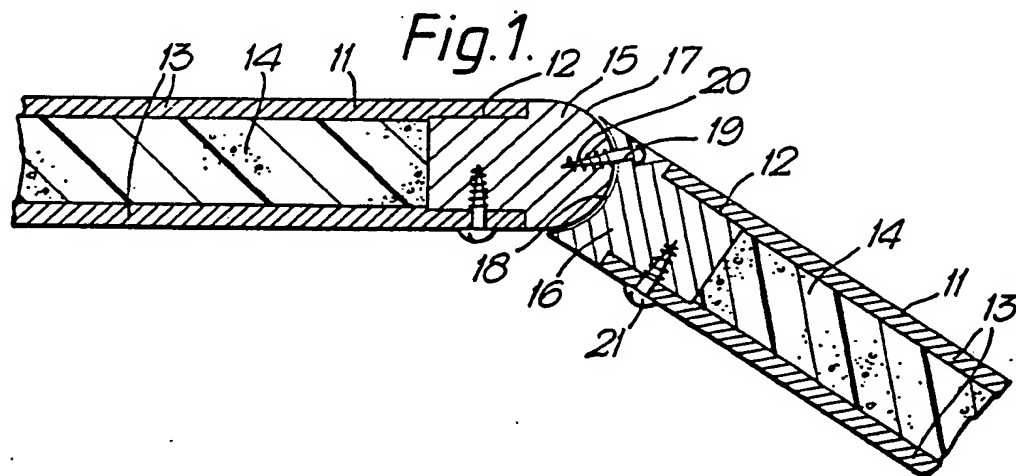


Fig. 1.

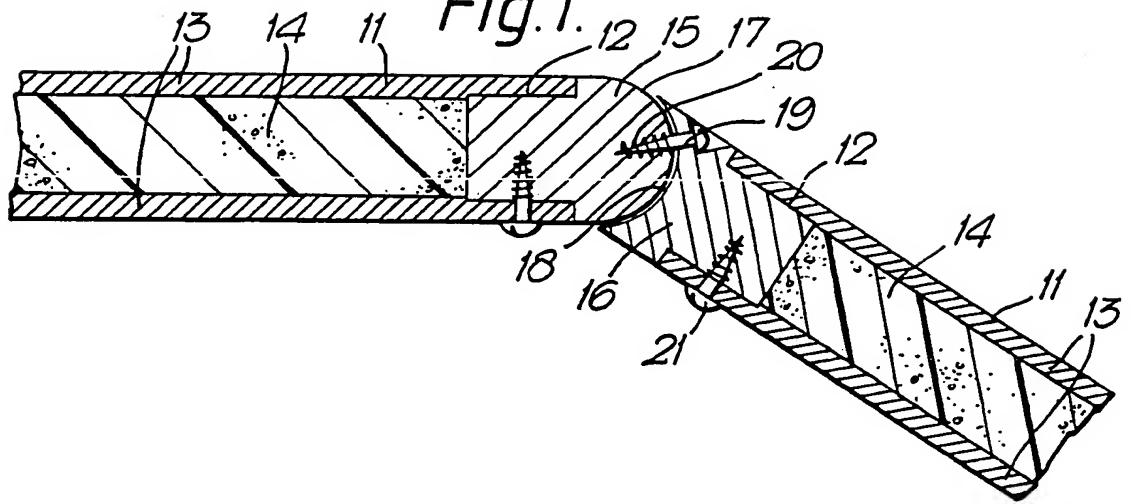


Fig. 2.

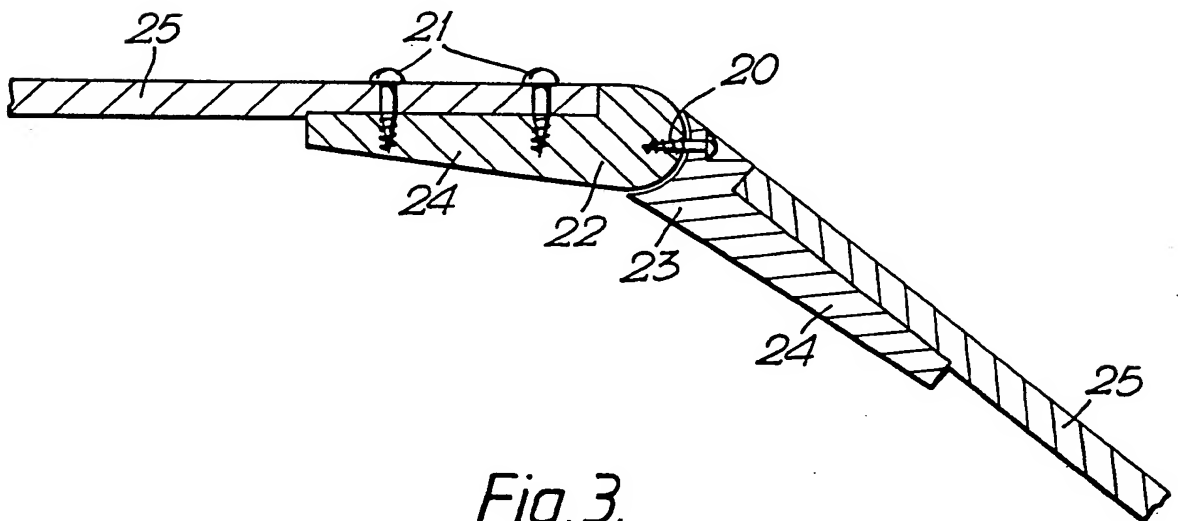
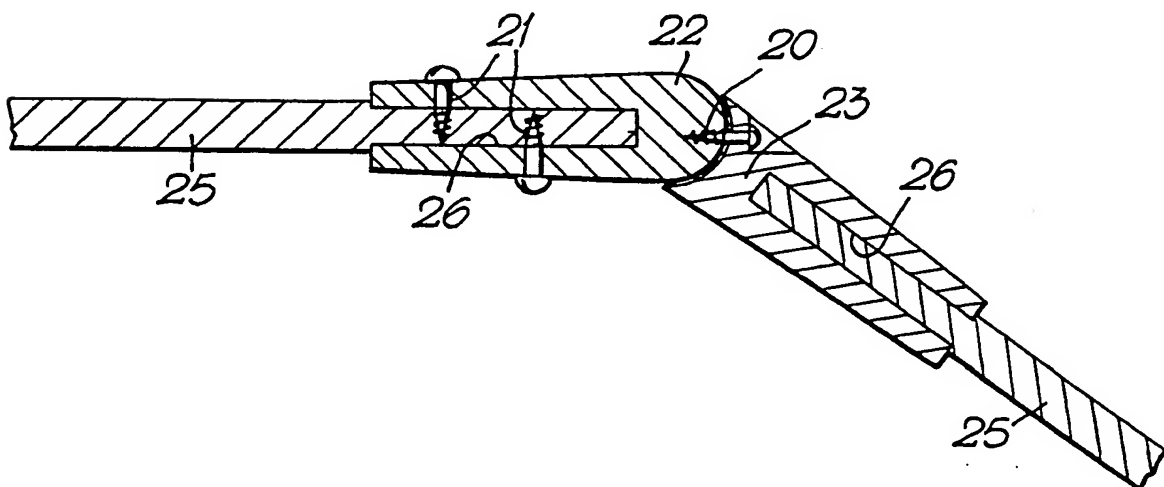


Fig. 3.



A method for joining the edges of panels and components.

This invention relates to the joining together of panels and components, especially those manufactured of fibre reinforced plastics materials.

The use of fibre reinforced plastics (FRP) and in particular glass fibre reinforced plastics (GRP) for the manufacture of boats and other structures is very common practice. With the introduction of more advanced fibre types and resins, these materials are being used for increasingly large and complex structures.

10 Typical FRP fabrication methods involve the moulding of various components which are then joined together along defined edges. For example, the hull and deck mouldings of a small boat are moulded separately and then typically joined along the deck edge. An alternative construction method
15 might involve the assembly of complex shaped structures from flat or single curvature panels, again joined together along their edges. For example, fully developable ship hull forms which consist of single curvature panels might be fabricated by manufacturing these panels in FRP and joining them together
20 along the chine lines.

In many cases a method for joining adjacent panels or components which is accurate, strong and suitable for both application to mass production or one-off construction is desirable.

The joining method herein described is suitable for a wide variety of joint configurations and geometries, provides a high degree of accuracy in assembly, can provide a strong and durable joint and is compatible with a variety of construction methods and scales of manufacturing operation.

According to the invention, preformed battens are provided which are fixed, as by glueing, along the edges of the panels or components to be joined, after which the battens on the respective panels or components are brought closely together and fixed to one another, as by screwing. Accurate and rigid location of the panels or components is thereby achieved and can be followed by further glueing and other joint finishing operations.

Particular arrangements according to the invention will now be described by way of example and with reference to the accompanying drawings.

In a particular embodiment of the invention shown in Fig. 1, for use with sandwich construction FRP panels or components 11, battens 15, 16 each have a tongue 12 which fits into the edge of a respective panel between the two skins 13 of the sandwich. The edge of the panel is first cut accurately to shape. Then the sandwich core material 14 is ground out to the depth of the tongue and the skins 13 ground to the correct thickness. The tongue is then glued in place using an appropriate high strength glue.

Two types of batten are employed in a particular joint which can conveniently be referred to as male and female. The male batten 15 has a part-circular cross-section nose 17 on it which fits into a part-circular recess 18 of similar radius running along the length of the face of the female batten 16. The mating circular faces allow for a range of included angles between the two components whilst still maintaining a substantial contact area between them.

Pre-drilled countersunk holes 19 are provided in the female batten 16 at an appropriate spacing along its length. During or after fit-up of the two FRP components, when the battens have been aligned together satisfactorily over a particular length, pilot holes are drilled into the nose 17 of the male batten and locating screws 20 put in to hold the components together. Glue can be applied to the faces of the joint before assembly or it can be injected into the joint after assembly. The fitting screws 20 provide precise location of the components and pulling together of the joint for either glueing method.

The arrangement using fitting screws also allows for trial assembly of complete structures before final assembly. This means, for example, that structures can have their components manufactured and trial assembled at the factory or manufacturing plant and then be finally assembled at a remote construction site with a high degree of accuracy.

Additional strength may be obtained with GRP reinforcement laid over the inside of the joint.

Screws 21 can also be used, if desired, to provide temporary fixing between a batten and its respective panel or component during glue curing.

In joints where high strength is not an important criterion it may be acceptable to use the fitting screws as the only permanent means of connection between the two components of the joint system, avoiding the need for application of glues. However, if watertightness or gas-tightness is required in this type of low strength joint then it may be necessary either to apply a liquid sealant to the joint faces or to fit a sealing strip of rubber or other suitable material into a groove in the face of either the male or female joint member. Alternatively, a sealing gasket can be fitted to the face of the joint.

In an alternative embodiment of the invention for application to single skin FRP panels, as shown in Figure 2, the male and female battens 22, 23 each have an offset tongue 24 whereby they can be lap-jointed to the edge margins of the respective panels 25 in such manner as to give a flush exterior to the joint. However, if a smooth external finish is not a priority, the arrangement of Figure 3 can be employed in which each batten has a slot 26 into which the edge of the respective panel is fitted. Again the edge of the panel

or component is accurately cut to shape and the surface prepared and ground to thickness. The battens can then be glued in place using an appropriate high strength glue.

The use of standard radii for the noses and recesses
5 of different types of batten and battens for different sizes of FRP component, will enable different types and sizes of FRP component to be joined easily in the same structure.

The precise selection of material for the battens will depend on their size and strength requirements. For most
10 applications they may be extruded or pultruded FRP, though non-fibre reinforced plastics can be appropriate for certain applications. Longitudinal grooves or channels may be formed in the faces of the joint components to allow for the post-assembly injection of glues, if required. They can also be
15 formed to allow for the fitting of a sealing strip in appropriate cases.

In a further embodiment of the invention this jointing method can be applied to structures made of other sheet materials, such as plywood or aluminium, where the included
20 angle between components is variable along the length of the joint. In such case edge battens manufactured of extruded aluminium or other materials may be appropriate.

CLAIMS:

1. A method of fabricating fibre reinforced plastics (FRP) structures, especially glass-fibre reinforced plastics (GRP) boats, wherein separate moulded FRP panels or components are joined together along their edges by the steps of:
 - 5 i) fixing two preformed battens with complementary mating surfaces along respective edges of the panels or components to be joined.
 - ii) bringing the edges of the panels or components with the battens together into desired assembly so that the
10 complementary surfaces of the battens are in mating relationship
 - iii) fixing the battens to one another, such as by screws, while maintaining said desired assembly of the panels or components
 - 15 iv) optionally bonding the battens to one another in said desired final relationship by means of glue or adhesive applied to the complementary mating surfaces before or after assembly.
2. A method according to Claim 1, wherein the panels or
20 components are single skin FRP panels and the battens are formed (in cross-section) with nose portions, that lie beyond the respective edges of the panels and bear the complementary mating surfaces, and tongue portions that are lap-jointed with the edge margins of the panels.

3. A method according to Claim 1, wherein the panels or components are single skin FRP panels and the battens are formed (in cross-section) with nose portions, that lie beyond the respective edges of the panels and bear the complementary mating surfaces, and slotted tail portions into the slots of which the edge margins of the panels are fitted and secured.
4. A method according to Claim 1, wherein the panels or components are double skin FRP panels of sandwich construction with a core material between the skins, and the battens are formed (in cross-section) with nose portions that lie beyond the respective edges of the panels and bear the complementary mating surfaces and tongue portions that are each fitted and secured in between the edge margins of the two skins of the respective panel, the core material of the sandwich being removed along the panel edge margin as necessary to accommodate the respective batten tongue.
5. A method according to any preceding Claim wherein the battens are bonded to the respective panels or components by glue or adhesive.
6. A method according to Claim 5, wherein fitting screws are employed to fix the battens to the respective panels or components while the glue is curing.
7. A method according to any preceding Claim, wherein the complementary mating surfaces of the battens are, in cross-

section, respectively convex part-circular and concave part-circular thereby enabling panels fitted with the battens to be assembled at a variety of relative angles.

8. A method according to any preceding Claim, wherein
5 the battens are of extruded or pultruded FRP.
9. A method according to any preceding Claim, wherein a sealant or sealing gasket is applied at the joint between the mating surfaces of the battens.
10. A method according to any preceding Claim, wherein
10 the battens have grooves or channels for the post-assembly injection of glue into the joint.
11. An FRP structure formed by the method of fabrication of any of the preceding Claims, in which two panels are jointed to one another at an angle that varies along the joint.
- 15 12. A method of fabrication of an FRP structure substantially as described with reference to Figure 1 or Figure 2 or Figure 3 of the accompanying drawings.